Solid Earth

ES-3 The student will demonstrate an understanding of the internal and external dynamics of solid Earth.

ES-3.4 Explain how forces due to plate tectonics cause crustal changes as evidenced in earthquake activity, volcanic eruptions, and mountain building.
Taxonomy level: 2.7-B Understand Conceptual Knowledge

Previous/future knowledge: Students in 8th grade (8-3.7) illustrated the creation and changing of landforms due to volcanic eruptions and mountain-building forces but it was not necessarily tied to the forces due to plate tectonics.

It is essential for students to know that many crustal changes occur because of the forces interact at and within plate boundaries.

- *At diverging boundaries*, where forces on the plates are pulling them apart, new crustal material forms as volcanic eruptions bring magma up to the surface. Earthquakes often accompany a volcanic eruption. Undersea mountain ridges are built from this activity as magma cools and hardens.
- *At converging boundaries*, the force of plates being pushed together may form deep undersea trenches. Volcanic eruptions occur as some magma is forced back to the surface to form either volcanic arcs or volcanoes within mountain ranges. Converging forces may slowly push continental crust against continental crust so that the land crumples and folds to form a mountain range.
- *Along transform fault boundaries*, as plates slide past each other, the build up of pressure along the boundary may cause the fault to quickly move resulting in an earthquake.
- Some volcanoes are located far from plate boundaries in regions known as *hot spots*.
  - These are formed where high-temperature mantle material rises toward the surface in plumes that melt crustal rock turning it to magma.
  - The magma melts through the crust to form volcanoes.
  - A trail of older volcanoes forms as a plate moves over a hot spot, such as the Hawaiian Islands.
  - Chains of volcanoes that form over hot spots provide important information about plate motions, such as rate and direction.

  Students may find the study of the hot spot beneath the Yellowstone Basin in Wyoming an interesting study.

It is not essential for students to know about forces that cause crustal change and activities within tectonic plates.

Assessment Guidelines:
The objective of this indicator is to *explain* crustal changes due to the forces of plate tectonics; therefore, the primary focus of assessment should be to construct cause and effect models of how tectonic forces could result in earthquake activity, or volcanic eruptions, or mountain building.
In addition to *explain* appropriate assessments may require students to:

- *interpret illustrations* to determine the cause of the feature; or
- *summarize* activities that occur to Earth's crust because of plate tectonic forces.